LittleFoot-CD

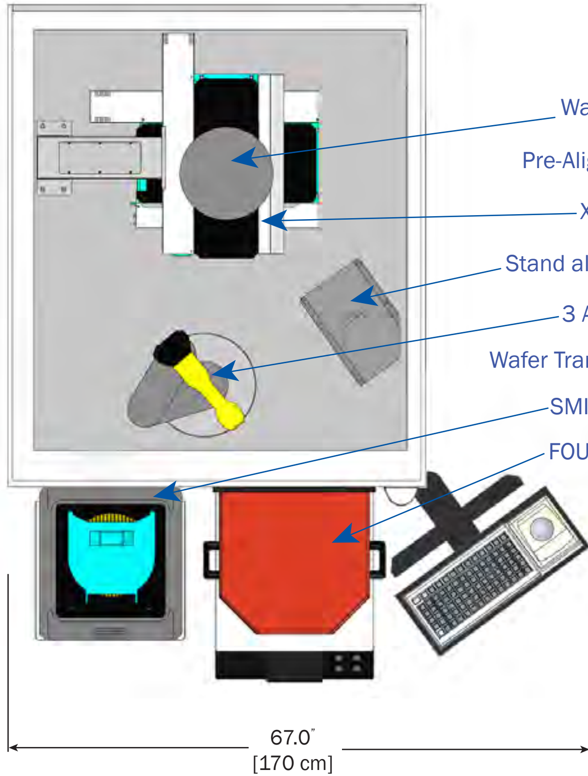
Ultra-High Resolution &
Ultra-High Sensitivity Scatterometer with
Thin Film Measurement Capabilities and
Reduced Footprint for 200 mm and 150 mm Wafers

FULLY AUTOMATED, HIGH THROUGHPUT OPTICAL METROLOGY SYSTEM FOR SEMICONDUCTOR APPLICATIONS. APPROXIMATELY 40% REDUCTION IN FOOTPRINT COMPARED TO OTHER METROLOGY TOOLS.

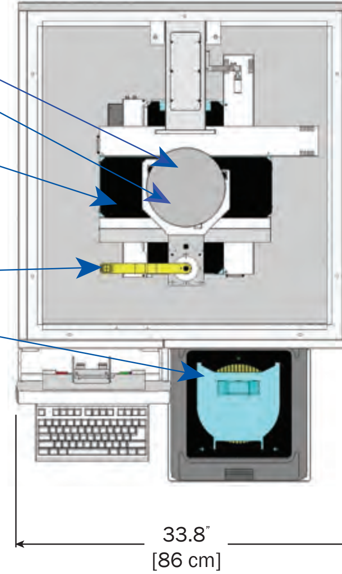
n&k® the true measure

LittleFoot-CD

n&k OptiPrime Series
Conventional Wafer Handling Technology



LittleFoot Series
Revolutionary Wafer Handling Mechanism



KEY QUALITIES OF LITTLEFOOT-CD

- *~40% Smaller Footprint then Standard Tools Translates into Significant Savings in the Construction and Utilization of Wafer Fabs*
- *Optimized Polarized Reflectance (Rs and Rp) Data*
  - *Wavelength Range: 190 – 1000 nm in 1 nm Intervals*
  - *Micro-Spot Technology*
- *Identical Analytical Capabilities as the n&k OptiPrime-CD*
- *Can be Configured for 200 mm (8") and 150 mm (6") Wafers*
- *Fully Automated*
- *Based on Patented Reflective Optics that Optimizes the Signal-to-Noise Ratio*
- *Strong Sensitivity to Sub-Nanometer Material Variations*
- *Thin Film Measurements:*
  - *Thickness, n and k (from 190 – 1000 nm)*
- *OCD Metrology for 2-D and 3-D Structures (Trenches and Contact Holes)*
  - *Depth, CD, Profile*
- *Cognex Pattern Recognition Software*
- *No Re-Alignment Issue Upon Light Bulb Replacement*
- *Modular design – Easy to Maintain and Service*
- *GEM/SECS Communication Interface*
- *SEMI Standard and Third Party Certifications*

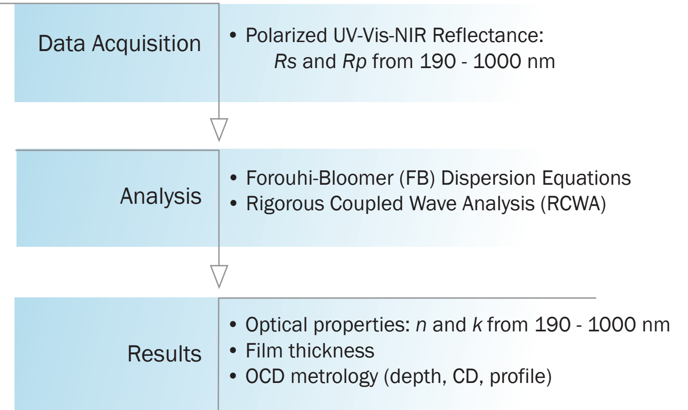
OPTICAL METROLOGY REQUIREMENTS FULFILLED BY LITTLEFOOT-CD

- *Optimized Signal-to-Noise Ratio & Large Dynamic Range of Detection*
- *Wide Wavelength Range (190-1000 nm) & High Resolution*
- *Physically Valid Model (Forouhi-Bloomer and RCWA)*
- *User-Friendly, Proprietary Software*
- *Unlike competitive systems, the n&k LittleFoot-CD has the capability to analyze any new film without sending samples to the factory*

PHYSICAL CHARACTERISTICS

Dimensions (W x D x H):	*86 cm x 121 cm x 180 cm*
Weight (unpacked):	*300 Kg*
Facility Requirements:	*100 - 240 VAC, 50/60 Hz, 1Φ* *Vacuum*

SYSTEM OPERATION FLOW



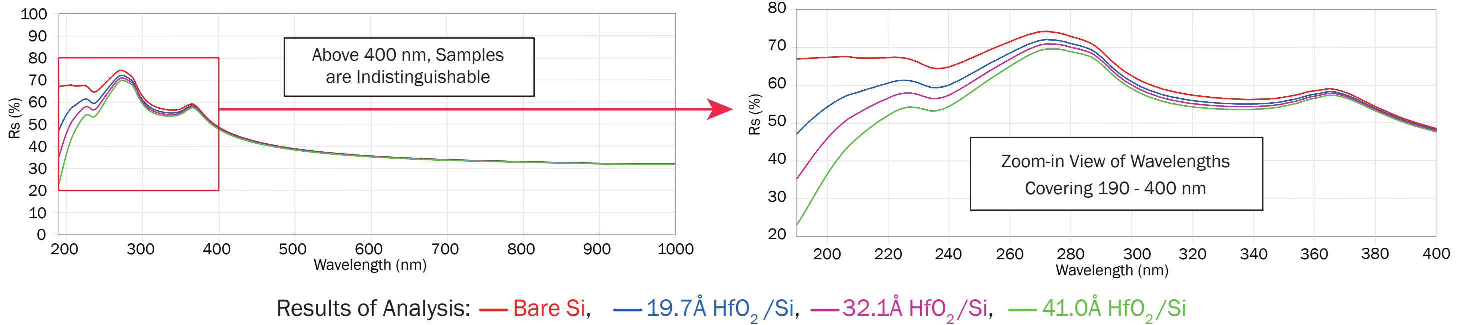
Thin Film Application Examples

The n&k LittleFoot-CD's thin film applications cover both current and next generation thin film measurement demands for R&D and production: Ultra Thin Films and Residual Layers, Multi-Layer Stacks, Inhomogeneous Films, 193 nm and 248 nm ARCs and Resists, Low-κ Films, High-κ Films, and films deposited on practically any substrate.

HIGH-K GATE INSULATORS: ATOMIC LAYER DEPOSITION (ALD)

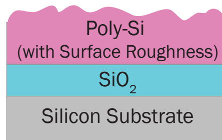
- DUV wavelengths are necessary in order to distinguish the ultra-thin HfO_2 films
- Measurement examples of HfO_2 on a Si-Substrate demonstrates that the tool has plenty of sensitivity in the DUV for this measurement

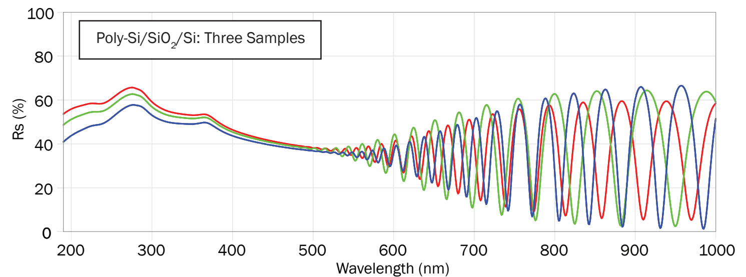
HfO_2 (20 - 40 Å)
Silicon Substrate



ROUGH POLY-Si ON SiO_2

- The wide wavelength range (190 - 1000 nm) of the LittleFoot-CD is needed in order to simultaneously measure the surface roughness and film thickness values
- The data is sensitive to the *n* and *k* values of the Poly-Si layer, which can be measured to determine the silicon properties (from amorphous to crystalline)

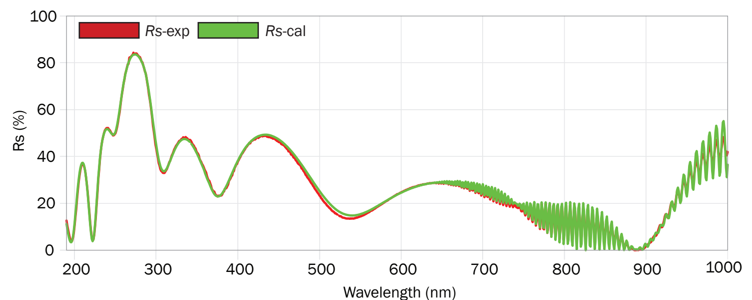


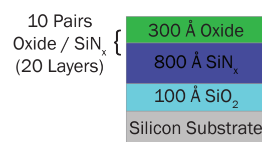


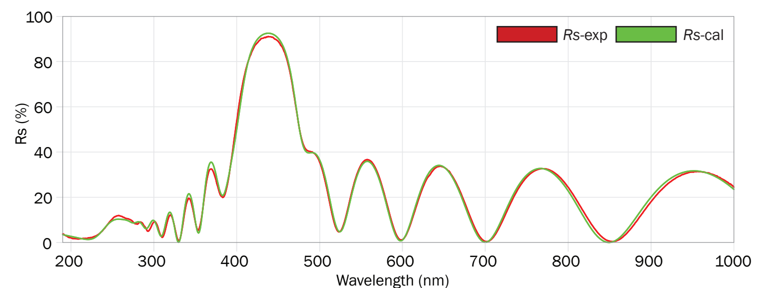
Spectra	Surface Roughness (Å)	Poly-Si Thickness (Å)	SiO_2 Thickness (Å)
Red	32	18245	505
Green	57	15078	622
Blue	85	21330	765

COMPLEX MULTI-LAYER FILM STRUCTURE

- Complex multilayer film stacks can be measured with the LittleFoot-CD
- Super structures, with sets of repeating layers, can be fully modeled in the analysis software
- Film stacks containing over 80 layers have been successfully measured



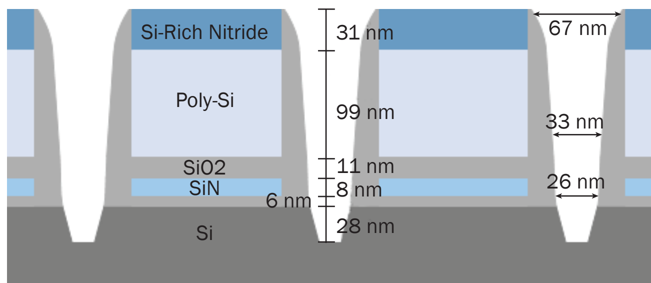




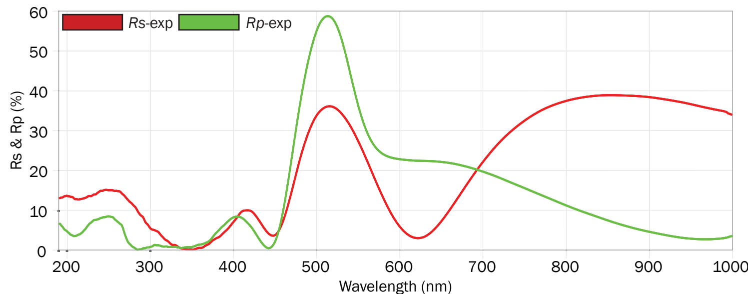
OCD Scatterometry Application Examples

The n&k LittleFoot-CD's OCD scatterometry applications cover structures with very large pitches and very small pitches, 2-D and 3-D complex structures including films inside and outside of shallow and deep trenches and contact holes. Because of our patented and unique optical design, n&k Technology offers the highest signal-to-noise ratio and lowest cost of ownership to support your OCD requirement.

2-D COMPLEX STRUCTURE

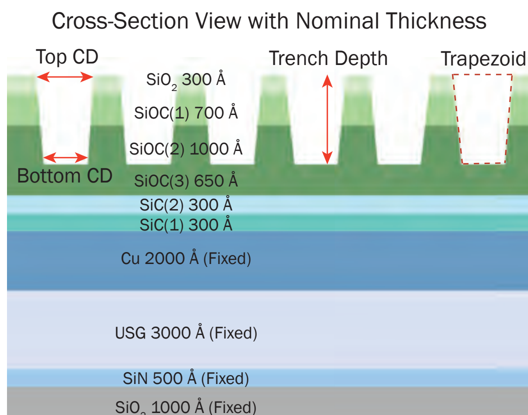


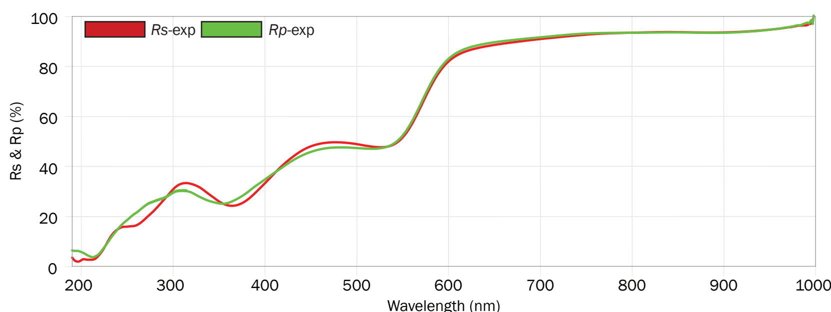
n&k Results - Cross Sectional View



Experimental Spectra Showing Distinct *Rs* and *Rp* Polarized Spectra

MEASUREMENT OF THIN FILMS, DEPTH, TOP CD AND BOTTOM CD

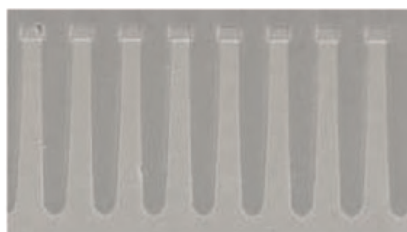




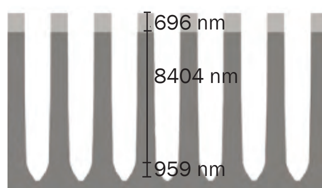
OCD Results:	Thickness Results:	
Trench Depth = 1416 Å	SiO_2 = 252 Å	SiOC (3) = 632 Å
Top CD = 79 nm	SiOC (1) = 404 Å	SiC (2) = 290 Å
Bottom CD = 61 nm	SiOC (2) = 760 Å	SiC (1) = 295 Å

PROFILE COMPARISON WITH FIB AND X-SEM

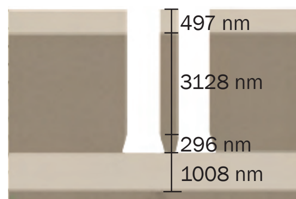
Cross Section



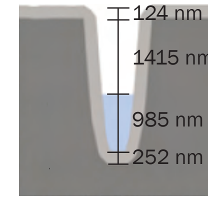
n&k Results



SiO_2 on Si Trench



SOI Trench (Flared CD Bottom)



Poly Recess Trench

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